QC Review Page

Record of Decision
Site 35, Operable Unit Number No. 10

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

CLEAN 1000 Program
Contract Number N62470-08-D-1000
Contract Task Order 081

Prepared by

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November 2009

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Final

Record of Decision
Operable Unit 10, Site 35

Marine Corps Base Camp Lejeune, North Carolina

November 2009

1 Declaration

Site Name and Location

This Record of Decision (ROD) presents the Selected Remedy for Site 35, Operable Unit (OU) 10, Former Camp Geiger Fuel Farm, at Marine Corps Base (MCB) Camp Lejeune, Jacksonville, North Carolina. MCB Camp Lejeune was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) effective November 4, 1989 (EPA ID: NC6170022580). As a result of the NPL listing and pursuant to Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the USEPA Region 4, the North Carolina Department of Environment and Natural Resources (NCDENR), the United States Department of the Navy (Navy), and the Marine Corps entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune in 1991. The primary purpose of the FFA is to ensure that the environmental impacts associated with past and present activities at the Base are thoroughly investigated. The Installation Restoration Program (IRP) is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. No enforcement activities have been recorded at Site 35.

Statement of Basis and Purpose

The remedy was selected in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for the site. Information not specifically summarized in this ROD or its references but contained in the Administrative Record has been considered and is relevant to the selection of the remedy at OU 10. Thus, the ROD is based upon and relies upon the entire Administrative Record file in making the decision.

The Navy is the lead agency and provides funding for site cleanups at MCB Camp Lejeune. The remedy set forth in this ROD has been selected by the Navy, MCB Camp Lejeune, and USEPA. NCDENR, the support regulatory agency, actively participated throughout the investigation process and, hence, has reviewed this ROD and the materials on which it is based and concurs with this Selected Remedy (Appendix A).

Scope and Role of Response Action

OU 10 is one of 22 OUs in the IRP that are part of the comprehensive environmental investigation and cleanup currently being performed at MCB Camp Lejeune under the CERCLA program. The status of all the IRP sites at MCB Camp Lejeune can be found in the current version of the Site Management Plan (SMP), which is located in the Administrative Record. OU 10 is solely comprised of Site 35.

Two interim RODs for Site 35, one for contaminated soil and one for the northeast portion of the shallow groundwater plume near the former fuel farm, were executed in 1994 and 1995, respectively. The Selected Remedy for soil was excavation and offsite disposal of contaminated soils. The Selected Remedy for groundwater was *in-situ* air sparging using a vertical trench. The air sparging system is currently still in operation; however, the Selected Remedy in this ROD is for the entire shallow and intermediate groundwater plume and the existing air sparging system will be discontinued. This ROD documents the final remedial action for Site 35, supersedes any previous RODs, and does not include or affect any other sites at the facility.

1.1 Selected Remedy

Assessment of the Site

The response action selected in this ROD is necessary to protect the public health, welfare, and/or the environment from actual or threatened releases of hazardous substances. Previous investigations have identified the presence of chlorinated volatile organic compounds (CVOCs) including 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC); and benzene in groundwater at concentrations that pose a potential threat to human health if used as a potable water supply. The response action for Site 35 addresses CVOC and benzene contamination in shallow and intermediate groundwater.

The Selected Remedy for Site 35 is Air Sparging using a Horizontal Well, Monitoring of the Natural Degradation of Chemicals of Concern (COCs), and Land Use Controls (LUCs). Long-term groundwater monitoring will be conducted and LUCs will be maintained on groundwater and associated property use within the boundaries of Site 35 until the concentrations of hazardous substances in the groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure.

Statutory Determinations

The Selected Remedy meets the statutory requirements and is protective of human health and the environment, complies with federal and state regulations that are applicable or relevant and appropriate to the remedial action, is cost-effective, utilizes permanent solutions to the maximum extent practicable, and satisfies the preference for treatment as a principle element of the remedy. Because this remedy will result in pollutants or contaminants remaining onsite in groundwater above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after the initiation of the remedial action to ensure that the remedy is protective of human health and the environment.

1.2 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record[1] file for MCB Camp Lejeune, Site 35.

- COCs and their respective concentrations (Section 2.3 and associated tables)
- Baseline risk represented by the COCs (Section 2.5)
- Cleanup levels established for COCs and the basis for these levels (Section 2.7)
- How source materials constituting principal threats will be addressed (Section 2.6)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.4)
- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (Section 2.9.3)
- Estimated capital costs, annual operation and maintenance (O&M) costs, and total present-worth costs, and the number of years over which the remedy costs are projected (Section 2.8 and Table 6)
- Key factors that led to selecting the remedy (i.e., a description of how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.9)

If contamination posing an unacceptable risk to human health or the environment is discovered after execution of this ROD, the Navy and MCB Camp Lejeune will undertake all necessary actions to ensure continued protection of human health and the environment.

[1] **Bold blue text identifies detailed site information available in the Administrative Record and listed in the References Table.**

1.3 Authorizing Signatures

This ROD presents the Selected Remedy at Site 35, OU 10, Former Camp Geiger Area Fuel Farm, at the MCB Camp Lejeune, located in Onslow County, North Carolina.

19 Oct 09

R. F. Flatau, Jr.
Colonel, United States Marine Corps
Commanding Officer
Marine Corps Base, Camp Lejeune

Date

11/16/09

Franklin E. Hill, Director
Superfund Division
U.S. Environmental Protection Agency Region 4

Date

With concurrence from:

11-5-09

Dexter R. Matthews, Director
Division of Waste Management
North Carolina Department of Environment and Natural Resources

Date

2 Decision Summary

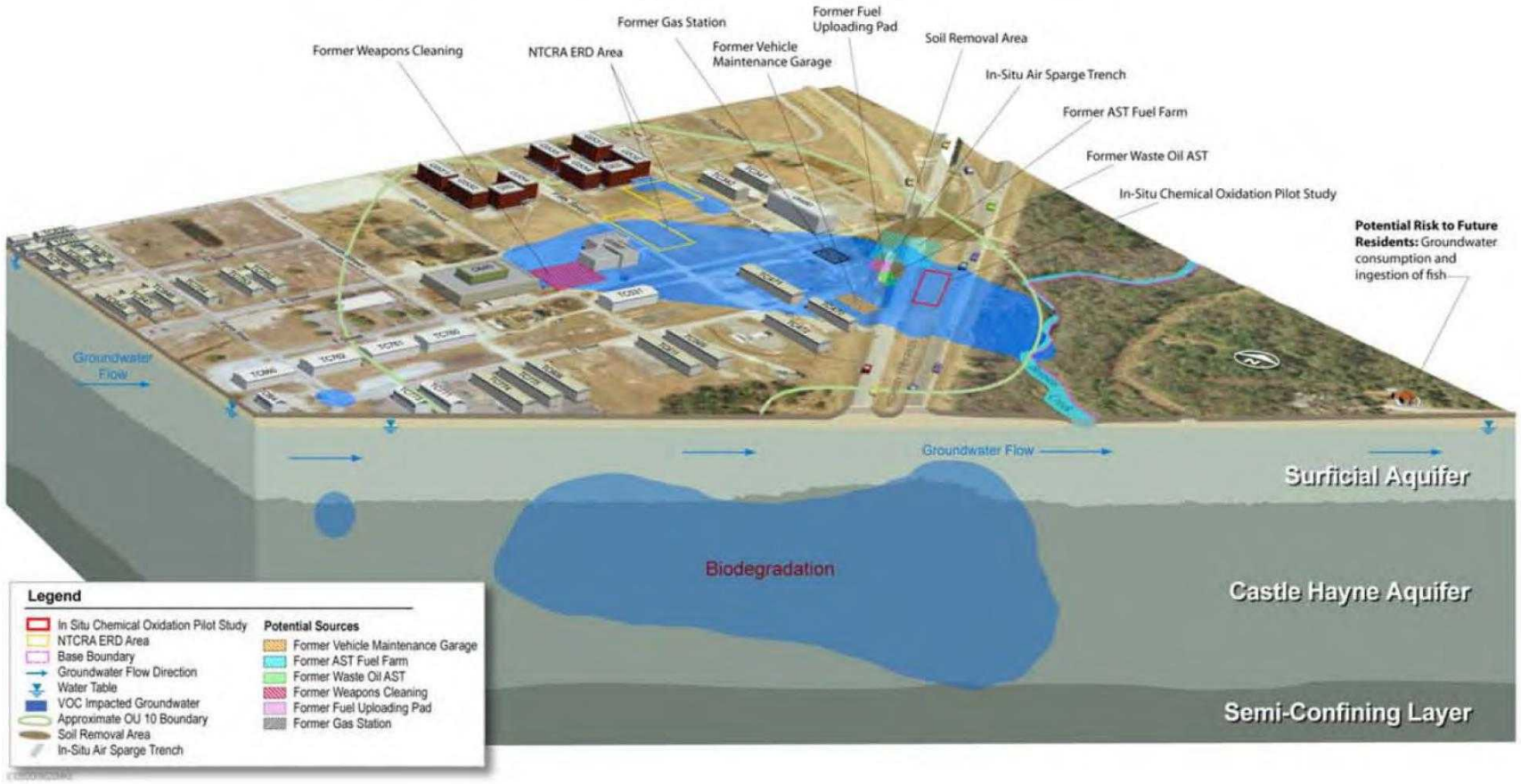
2.1 Site Description and History

MCB Camp Lejeune is a 156,000-acre facility located in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville (Figure 1). The mission of MCB Camp Lejeune is to maintain combat-ready units for expeditionary deployment. The Base provides housing, training facilities, and logistical support for Fleet Marine Force units and other assigned units.

FIGURE 1
Base and Site Location Map

Site 35 is located within Camp Geiger (Figure 2) and was originally the former Camp Geiger Area Fuel Farm in use from 1945 to 1995. The fuel farm was composed of five 15,000-gallon aboveground storage tanks (ASTs); underground fuel transmission lines; a pump house; a fuel unloading pad; an oil-water separator; and a distribution island, situated north of the intersection of Fourth Street and 'G' Street. Fuels stored at the Camp Geiger fuel farm included No. 6 fuel oil, kerosene, diesel, and gasoline. **Several releases were reported** during the active life of the fuel farm. A vehicle maintenance garage (former Building TC474, north of Building TC470) and weapons cleaning area (south of Building G560) were also present at Site 35.

FIGURE 2
Conceptual Site Model



2.2 Site Characteristics

The ground surface of Site 35 is generally flat; with the exception of the US Highway 17 Bypass, which is at a higher elevation than the rest of the site. The eastern portion of the site, beginning at the Bypass, is heavily wooded and slopes toward Brinson Creek. Stormwater across the site is conveyed via manmade drainage ditches, storm drains, and catch basins, and discharges to Brinson Creek and its tributaries, where it then flows southeast into the New River.

The surficial and Castle Hayne **aquifers at Site 35** are divided into three depth zones: shallow (2.5 to 25 feet [ft] below ground surface [bgs] – surficial aquifer), intermediate (25 to 45 ft bgs – upper Castle Hayne Aquifer), and deep (45 to 65 ft bgs – middle Castle Hayne Aquifer). The Castle Hayne confining unit observed between the surficial and Castle Hayne Aquifers across most of the Base is either not present or is laterally discontinuous at Site 35, suggesting that a hydraulic connection exists between the shallow and intermediate aquifer zones. This is also indicated by the historical nature and shape of the shallow and intermediate contaminant plumes. The shallow aquifer zone is characterized by undifferentiated silty sands with intermittent clay lenses ranging from 0.1 to 0.5 ft thick. The intermediate and deep zones are primarily composed of cemented sands and shell fragments with interbedded silty sand layers. One of the silty sand layers at approximately 46 ft bgs acts as a semi-confining layer that has prevented contaminant migration to the deeper aquifer zone.

In general, groundwater flow direction within the shallow, intermediate, and deep aquifer zones at Site 35 is to the northeast towards Brinson Creek. The shelly cemented sands within the intermediate and deep zones appear to provide a more conductive zone for groundwater movement as compared to the undifferentiated silty sands of the shallow zone. The **average hydraulic conductivity** (groundwater velocity) in the shallow zone is 0.63 ft/day, whereas the average hydraulic conductivities for the intermediate and deep zones are 4.2 ft/day and 6.5 ft/day.

2.3 Previous Investigations

The contamination at Site 35 was characterized under numerous investigations and studies between 1983 and the present (Table 1). These investigations have concluded that the **COCs at Site 35** are 1,1,2,2 PCA, PCE, TCE, their daughter products (cis-1,2-DCE and VC) and benzene in groundwater. The source of the CVOC contamination in the northern area of Site 35 is likely from the former vehicle maintenance garage and the former weapons cleaning area east of Building G533. The source of the smaller dissociated southern plume is unknown but is also likely related to the historic use of solvents for maintenance and equipment cleaning. The Camp Geiger fuel farm is the likely source of the benzene contamination.

The **sampling strategy** at Site 35 has focused on delineating the nature and extent of CVOC and benzene contamination present that would pose a threat or potential threat to public health or welfare or the environment. Additionally, with the advent of several **pilot studies**, the sampling strategy has transformed into a monitoring program to evaluate plume stability and contaminant attenuation over time. Over the course of investigative activities, approximately 750 groundwater, 226 soil samples (surface and subsurface combined),

14 sediment samples, and 36 surface water samples were collected. The respective investigations are part of the Administrative Record and can be referenced for further details for specific sampling strategies, media investigations, and when and where the sampling was performed.

TABLE 1
Previous Studies and Investigations

Previous Study / Investigation*	Date of Investigation	Investigation Activities
Initial Assessment Study (WAR, 1983)	1983	Site 35 was identified for further study due to potential for petroleum hydrocarbon impacts from historical site activities and recorded spills.
Confirmation Study (ESE, 1985)	1985	Soil, groundwater, and surface water samples were collected to delineate contamination. Results indicated soil and groundwater were potentially impacted by site activities.
Focused Feasibility Study (FS) (NUS Corporation, 1990)	1990	Soil, groundwater, surface water, and sediment samples were collected in the area of the 1990 petroleum release. Risks to human health or the environment and interim measures to remediate the area were evaluated. No unacceptable risks were found. Remediation was recommended because petroleum hydrocarbon levels exceeded cleanup standards.
Comprehensive Site Assessment (Law, 1992)	1991 to 1992	Soil and groundwater samples were collected to identify the source, nature, and extent of petroleum hydrocarbon impacts. Petroleum-hydrocarbon-related contamination was found in soil (generally located at or below groundwater table) and in shallow groundwater. CVOC contamination was found in shallow and intermediate groundwater.
Interim Remedial Action Remedial Investigation/Feasibility Study (RI/FS) (Baker, 1994)	1993 to 1994	Additional soil samples were collected for petroleum hydrocarbons to support selection of an interim remedial action.
Interim Record of Decision (ROD) for Contaminated Soil (Baker, 1994)	1994	Selected Remedy was excavation and offsite disposal of **contaminated soil**.
RI (Baker, 1995)	1994 to 1995	Soil gas, soil, groundwater, surface water, and sediment samples were collected to evaluate the nature and extent of contamination and potential risks to human health and environment. Primary impacted media was groundwater: COCs included petroleum hydrocarbons (primarily benzene), CVOCs (primarily TCE and cis-1,2-DCE), and metals.
Interim FS for Surficial Groundwater for a Portion of OU 10 (Baker, 1995)	1995	Addressed groundwater impacts and identified remedial actions for a focused area near the fuel farm, a known source of groundwater contamination.
Interim ROD for Surficial Groundwater (Baker, 1995)	1995	Issued based on the Interim FS for remediation of surficial groundwater near the fuel farm. **Air sparging** using a vertical trench was the Selected Remedy.
Supplemental Groundwater Investigation (SGI) (Baker, 1996)	1995 to 1996	Soil, groundwater, surface water, and sediment samples were collected to fill data gaps from the RI and support the air sparging pilot study. COC driving risks were benzene, TCE, cis-1,2-DCE, and arsenic.
Draft *In-situ* Air Sparging Treatability Study (Baker 1996)	1996	Pilot study for *in-situ* air sparging in the shallow aquifer; results indicated that air sparging had limited effectiveness for volatile organic compound (VOC) removal.
Closeout Report (Soil Removal Action) (OHM, 1997)	1995 to 1997	Remedial action response to the interim ROD for soil at Site 35. Approximately 15,700 tons of contaminated **soil was removed** from the former fuel farm area.
Long-term Monitoring (LTM) (CH2M HILL, 2005)	1999 to 2004	Groundwater samples were collected, quarterly in 1999 and semiannually from 2000 to 2004, to assess seasonal changes in contaminant distribution. Since Site 35 is under ongoing investigations, **LTM was discontinued** in 2004 based on the recommendation of the 2005 report.

TABLE 1
Previous Studies and Investigations

Previous Study / Investigation*	Date of Investigation	Investigation Activities
Natural Attenuation Evaluation (CH2M HILL/Baker/CDM, 2003)	1998 to 2002	Seasonal changes, plume stability, and presence of natural degradation were evaluated. Results indicated natural attenuation was degrading CVOCs but **biological degradation** appeared stalled in some locations.
Hot Spot Characterization (Baker, 2003)	2003	Further delineation and characterization of two TCE hot spots (concentration > 280 micrograms per liter [µg/L]) was conducted. One shallow hot spot was co-mingled with petroleum hydrocarbons near Building G480, and a deeper, larger hot spot extended from Building TC470 under the US Highway 17 Bypass to wetland area west of Brinson Creek.
Technical Evaluation (CH2M HILL, 2003)	2003	Developed and evaluated remedial action alternatives for groundwater. *In-situ* chemical oxidation (ISCO) via modified Fenton's Reagent followed by potassium permanganate was recommended for TCE removal. *In-situ* air sparging with vertical wells was recommended for the petroleum hydrocarbon contamination.
Pilot Study (CH2M HILL, 2006)	2003 to 2005	Evaluated the effectiveness of ISCO for the remediation of TCE-impacted groundwater. TCE was reduced by 80 to 98 percent and total VOCs were reduced by 72 to 85 percent within the pilot study area.
Supplemental RI (CH2M HILL, 2009)	2005 to 2008	Soil, groundwater, surface water, and sediment samples were collected to delineate the extent of contamination. No unacceptable risks in all media except groundwater. Benzene and several CVOCs were detected in groundwater exceeding North Carolina Groundwater Quality Standards (NCGWQS) and/or USEPA Maximum Contaminant Levels (MCLs).
Non-time-critical Removal Action (NTCRA) (CH2M HILL, 2008)	2006 to 2008	Enhanced reductive dechlorination (ERD) via injection of emulsified vegetable oil and lactate using direct-push technology was evaluated to address CVOCs in groundwater east of Building G533. Results indicated minimal reduction of COCs.
FS Site 35 - OU 10 (CH2M HILL, 2009)	2009	The following remedial alternatives for CVOC-impacted groundwater were assessed: no action, monitored natural attenuation, ERD with bioaugmentation, ISCO, and *in-situ* air sparging using a horizontal well.

Notes:

*Documents listed are available in the Administrative Record and provide detailed information to support remedy selection at Site 35.

Interim remedial actions and pilot studies (summarized in Table 1) have been conducted to address soil and surficial groundwater at Site 35 with varying degrees of success. The interim remedial action for contaminated soil included excavation and offsite disposal of soils identified during **site-wide sampling**. Confirmation samples collected after **excavation activities** indicated that the remaining soil onsite did not have contaminant concentrations exceeding regulatory action levels, and no further action for soil is required.

Groundwater treatment implemented to date has had limited success. This is primarily due to the distribution of injection treatments (e.g., bioremediation, vertical air sparging, chemical oxidation) based on the subsurface geology, low natural microbial populations for effective bioremediation, and deeper contamination than the location of the existing vertical air sparge trench. The cemented sands in the intermediate aquifer zone interrupt the distribution of injection treatments causing undesired flow paths. Additionally, silty sands in the shallow aquifer zone have low hydraulic conductivity, which inhibits the distance an injected treatment can travel through the aquifer. As a result, residual contamination is

present at levels exceeding regulatory action levels throughout Site 35. This ROD addresses the remaining contamination at Site 35, which is confined to groundwater in the shallow and intermediate aquifer zones. It is supported by the 2009 FS, which used the most recent (May 2008) comprehensive groundwater sampling results to assess remedial alternatives for current site conditions.

During the May 2008 comprehensive groundwater sampling event, VOCs were detected at concentrations exceeding NCGWQS or MCLs. The **analytical results** indicate the predominant VOCs exceeding NCGWQS or MCLs include TCE, cis-1,2-DCE, VC, and benzene. Additionally, PCE and 1,1,2,2-PCA were each detected in groundwater collected from four monitoring sites at concentrations exceeding the NCGWQS or MCLs.

The current extent of groundwater contamination at Site 35 is composed of two separate plumes: a large, diffuse plume generally extending from east of Building G533 towards Brinson Creek and a small plume located in the southeast portion of Site 35 generally extending from Building TC762 east to Building TC773. The lateral extents of the benzene, TCE, cis-1,2-DCE, and VC plumes in the shallow and intermediate aquifer zones are shown in Figures 3 and 4, respectively. The vertical extent of groundwater contamination at Site 35 is generally limited to approximately 46 ft bgs where the top of the semi-confining layer is located. Results of the most recent May 2008 sampling indicate that concentrations of VOCs are highest in the intermediate aquifer zone.

The primary fate and contaminant migration pathway for VOCs at Site 35 is through groundwater flow in the surficial and intermediate aquifer. The mechanisms of transport include dissolution, advection, and dispersion. Shallow groundwater discharges into Brinson Creek, which ultimately discharges into New River; however, analytical results indicate that there have not been any impacts above North Carolina Surface Water Quality Standards (NCSWQS) in Brinson Creek.

2.4 Current and Potential Future Site and Resource Uses

The site currently includes roadways, buildings, former building foundations, and several large parking areas. Portions of Site 35 are currently in use by the Camp Geiger School of Infantry. Armory operations, several warehouses, general storage buildings, and troop barracks occupy the area. Current land uses are expected to continue at Site 35, and there is no other planned future land use. LUCs will be implemented within the boundaries of the site to eliminate exposure to shallow and intermediate groundwater until the remedial action reduces concentrations of hazardous substances to levels that allow for unrestricted use and unlimited exposure.

Groundwater is not currently used as a potable water supply at or in the vicinity of Site 35. One public supply well is located within 1,500 ft upgradient of Site 35. It is inactive and has been recommended for abandonment.

FIGURE 3
Extent of Shallow Aquifer Zone Contamination

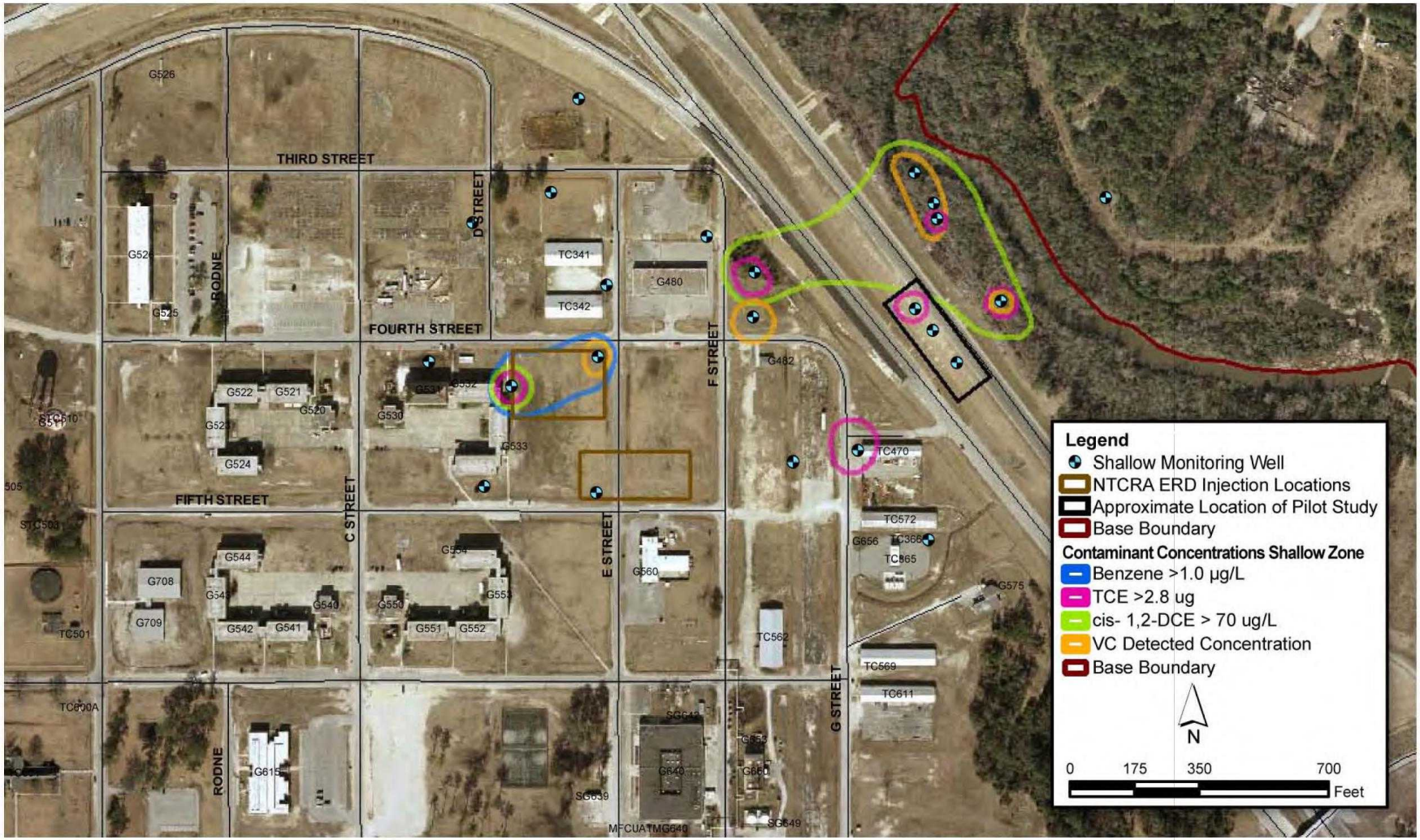
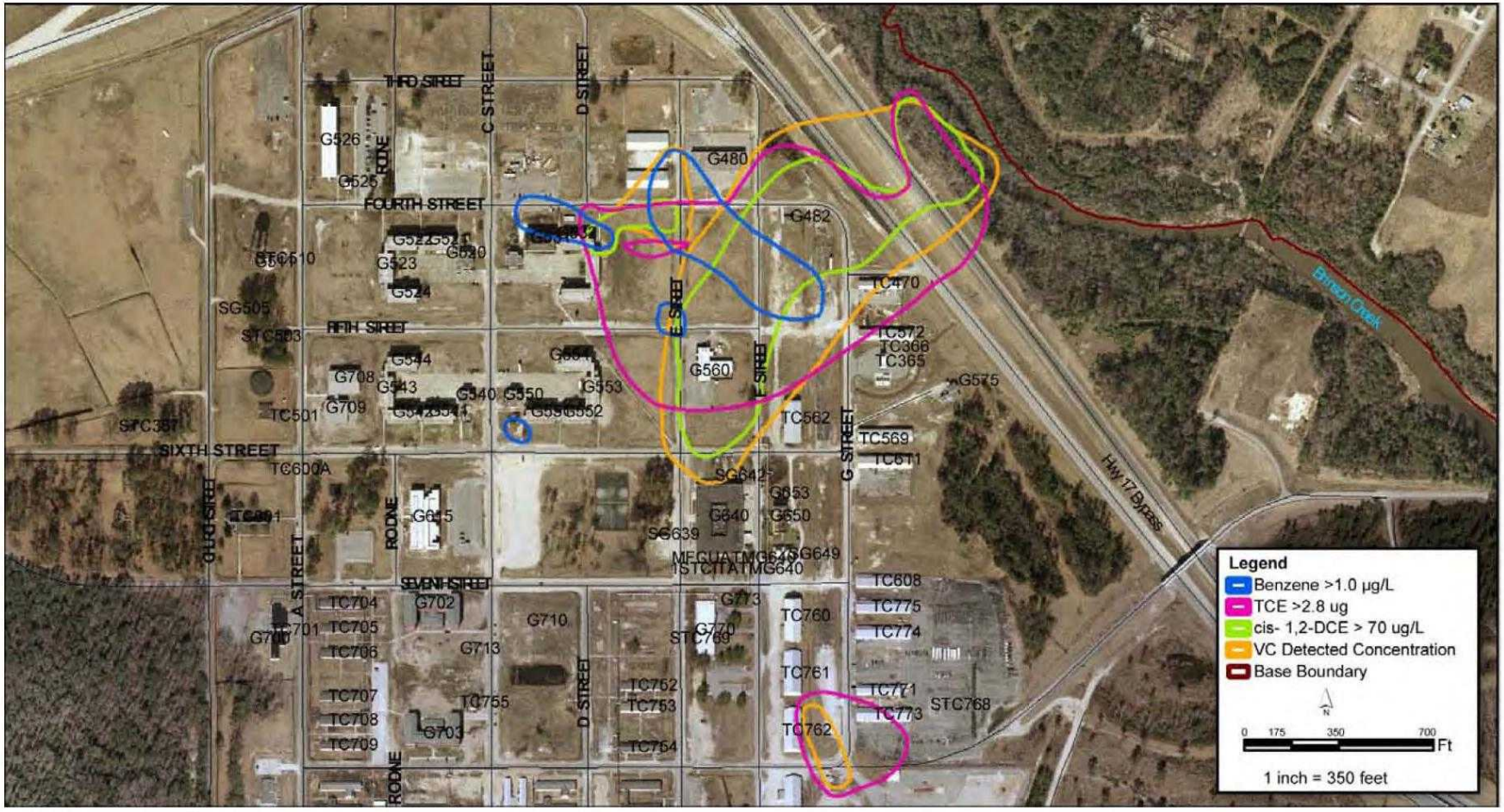


FIGURE 4
Extent of Intermediate Aquifer Zone Contamination



2.5 Summary of Site Risks

Potential human health and ecological risks at Site 35 were evaluated and documented in the RI, Supplemental Groundwater Investigation (SGI), and Supplemental RI. The Supplemental RI, following subsections, and Table 2 briefly summarize the findings of these risk assessments.

TABLE 2
Summary of Human Health and Ecological Risks by Media

Media	Human Health Risk	Ecological Risk
Surface Soil	Acceptable	Acceptable
Subsurface Soil	Acceptable	Not Applicable
Groundwater	Unacceptable	Not Applicable
Sediment	Acceptable	Acceptable
Surface Water	Acceptable	Acceptable
Fish and Crab Tissue	Acceptable	Acceptable
Benthic Macroinvertebrates	Not Applicable	Acceptable

2.5.1 Human Health Risk Summary

Human health risk assessments (HHRAs) were conducted to evaluate the potential human health risks associated with current and hypothetical future receptors. Environmental media evaluated include: surface soil, subsurface soil, shallow and intermediate groundwater, surface water, sediment, and fish tissue. **Potential receptors** include: current military personnel, current adult and child recreational users, future construction workers, and future adult and child residents. This information was used to determine if any further actions were needed to be taken at Site 35 to sufficiently protect human health.

Potential cancer and noncancer risks were calculated based on reasonable maximum exposure (RME). The RME assumes the highest level (maximum concentration) of human exposure that could reasonably be expected to occur. For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} (a 1 in 10,000 chance of developing cancer) and 10^{-6} (a 1 in 1,000,000 chance of developing cancer) using information on the relationship between dose and response. The 10^{-6} risk level is used as the point of departure for determining performance standards for alternatives when Applicable or Relevant and Appropriate Requirements (ARARs) are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure. A non-cancer hazard of 1.0 is used as an upper limit to which calculated hazard index (HI) values are compared. Any HI exceeding 1.0 indicates an existing non-cancer hazard.

The conclusions of the HHRA were that current site use and site-related impacts **do not pose an unacceptable risk** to human health. The only potential unacceptable risk to human health is to **future residential receptors** from ingestion of CVOCs in groundwater (Table 3).

TABLE 3
Summary of Potential Human Health Risks

Receptor	Media	Pathway	COC	Exposure Point Concentration (µg/L)	RfD (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	Non-Cancer Hazard (HI)	Cancer Risk
Future Adult Resident	GW	Ingestion	TCE	900	0.006	0.011	4.11	$1.16x10^{-4}$
			1,2-DCE (total)	970	0.01	NA	2.87	NA
Future Child Resident	GW	Ingestion	TCE	900	0.006	0.011	9.59	$5.42x10^{-5}$
			1,2-DCE (total)	970	0.01	NA	6.22	NA

Notes:

Potential unacceptable risks are shaded yellow.

GW = Groundwater; RfD = Reference Dose (noncancer toxicity factor); CSF = Cancer Slope Factor (cancer toxicity factor); NA = Not Applicable; HI = hazard index; µg/L = micrograms per liter

Although concentrations of benzene, PCE, and PCE degradation products 1,1,2,2-PCA and VC in groundwater did not pose unacceptable risk individually, the concentrations contribute to cumulative unacceptable risk and they were detected at concentrations above drinking water standards (i.e., MCLs or NCGWQS) and therefore are retained as COCs. Exposure Point Concentrations used in the HHRA are significantly higher than current contaminant concentrations. The maximum detected concentrations of COCs from the 2008 sampling event are provided below in Table 4.

2.5.2 Ecological Risk Summary

An ecological risk assessment (ERA) was completed to evaluate whether past site operations have adversely affected terrestrial and aquatic communities on or adjacent to Site 35. Soil, surface water, and sediment samples were compared to published values for toxicity in various aquatic and terrestrial species. In addition, fish, crabs, and benthic macroinvertebrates were collected and analyzed against toxicological information for contaminants detected in these media, which were then used to evaluate the potential adverse ecological effects to those receptors. The **point of exposure** included species living in, or coming into contact with, contaminated surface soil, or bioaccumulation from consumption of smaller organisms because bioaccumulation was considered likely to occur at Site 35.

The risk characterization evaluates the potential for decrease in the aquatic and terrestrial populations from contaminants identified at the site. The quotient index (QI) approach was used to characterize the risk to aquatic receptors from exposure to surface water and sediments and to terrestrial receptors from exposure to surface soil, surface water, and biota. A QI greater than 1 indicates a significant potential risk. The QI equation is dependent on exposure concentration, chronic daily intake, surface water screening values, sediment screening values, and terrestrial reference values.

Overall, the ERA concluded that no site-related risks to **terrestrial and aquatic receptors** were present at Site 35. Although minimal potential risks associated with **pesticides and**

metals in sediment were identified; they were determined not to be site-related as they were not attributed to historical site activities.

2.5.3 Basis for Response Action

It is the current judgment of the Navy, MCB Camp Lejeune, and USEPA, in concurrence with NCDENR, that the Selected Remedy in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Based on the HHRA, exposure to groundwater at Site 35 poses an unacceptable risk to human health due to the presence of TCE and cis-1,2-DCE. In addition, under North Carolina's groundwater classification, the surficial and Castle Hayne aquifers are considered Class GA, a potential source of drinking water. NCDENR identified NCGWQS as 'relevant and appropriate' Chemical-specific requirements for groundwater remediation of these aquifers. Remedial action at this site has been determined to be necessary due to unacceptable risk from potential human consumption of the contaminated groundwater and exceedance of the NCGWQS or MCLs (measures that define acceptable levels for drinking water). Benzene, 1,1,2,2-PCA, PCE, and VC, identified in groundwater at Site 35 above the NCGWQS (Table 4), are also considered COCs. 1,1,2,2-PCA and VC are degradation products of PCE and have the potential of creating future human health risk with an increase in contaminant concentrations.

TABLE 4
COCs Requiring a Response Action

Chemicals of Concern	Detection Frequency	Max Concentration (µg/L)	NCGWQS (µg/L)
Shallow Aquifer Zone			
Benzene	3/28	18	1
cis-1,2-DCE	13/28	150	70
TCE	10/28	24	2.8
VC	6/28	20	0.015
1,1,2,2-PCA	4/28	6.7	0.17
PCE	3/28	1.9	0.7
Intermediate Aquifer Zone			
Benzene	19/34	6.6 J	1
cis-1,2-DCE	29/34	240	70
TCE	25/34	180	2.8
VC	21/34	220	0.015
PCE	6/34	2.2	0.7

Notes:
J = Reported value is estimated
µg/L = micrograms per liter

2.6 Principal Threat Wastes

"Principal threat wastes" are source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should they be exposed. Contaminated groundwater generally is not considered to be a source material; however, nonaqueous phase liquids (NAPLs) in groundwater may be viewed as a source material. Dissolved concentrations of COCs in groundwater at approximately 1 to 5 percent of the solubility of a compound would suggest the presence of dense nonaqueous phase liquids (DNAPL) in the subsurface. The maximum concentrations of TCE, cis-1,2-DCE, and VC observed in the May 2008 sampling event at Site 35 were present in concentrations of less than 1 percent of their respective solubility. Therefore, DNAPLs are not considered to be principal threat wastes at Site 35. Light nonaqueous phase liquid (LNAPL) was not identified within the CVOC plume. Benzene has been detected at low concentrations with minimal risk to future receptors.

Because no significant source materials are present and there are no realistic exposure scenarios to COC-impacted groundwater, it can be concluded that there is no principal threat waste at Site 35.

2.7 Remedial Action Objectives

The remedial action objectives (RAOs) for Site 35 are based upon the potential of future residential receptors using groundwater as a potable supply. The RAOs for Site 35 are the following:

- Restore groundwater quality at Site 35 to the NCGWQS and MCL standards based on the classification of the aquifer as a potential source of drinking water (Class GA or Class GSA) under 15A NCAC 02L.0201, and to prevent human ingestion of water containing COCs (benzene, 1,1,2,2-PCA, PCE, TCE, cis-1,2-DCE, and VC) at concentrations exceeding NCGWQS or MCL standards, whichever is more stringent, until the remediation goals have been obtained.
- Minimize migration of COCs in groundwater to surface water.

Remediation goals to meet the RAOs are identified in Table 5.

TABLE 5
Remediation Goals for Groundwater

Chemical of Concern	NCGWQS (µg/L)
Groundwater	
Benzene	1
TCE	2.8
cis-1,2-DCE	70
VC	0.015
1,1,2,2-PCA	0.17
PCE	0.7

Notes:
µg/L - Micrograms per liter
NCGWQS: North Carolina Ground Water Quality Standards are more stringent than MCLs for some COCs

2.8 Description and Evaluation of Alternatives

2.8.1 Description of Alternatives

Remedial alternatives to address shallow and intermediate groundwater at Site 35 were developed and are detailed in the 2009 FS. Based on the **initial screening of technologies,** five remedial alternatives were retained for detailed comparative analysis and a description is provided in Table 6.

TABLE 6
Description of Remedial Alternatives

Alternative	Components	Details	Cost	
1 - No Action	None	None	**Total Cost**	**$0**
			Timeframe	**30 years**
2 – MNA / LUCs	MNA	Groundwater monitoring and reporting to assess the progress of natural attenuation over time.	Capital Cost	$83,025
			Present worth (PW) monitoring	$1,028,163
	LUCs	LUCs to prevent exposure to groundwater.	**Total Present Value**	**$1,111,188**
			Timeframe	**30 years**
3 – ERD with Bioaugmentation / LUCs	Enhanced bioremediation	Injection of microbial culture and electron source/substrate to promote anaerobic biodegradation of CVOCs by reductive dechlorination.	Capital cost	$1,520,721
			PW quarterly monitoring (yrs 1-2)	$251,276
			PW annual monitoring (yrs 3-20)	$707,947
			Total present value	**$2,479,944**
	Groundwater monitoring	Long-term groundwater monitoring and reporting to evaluate: -Effectiveness of the ERD injections -Potential impacts to surface water -Progress of natural attenuation over time -Potential migration to the deep aquifer		
	LUCs	LUCs to prevent exposure to groundwater.	**Timeframe**	**20 years**
4 – ISCO using Persulfate / LUCs	Chemical oxidation of VOCs	Injection of chemical oxidant and activation agent to chemically degrade VOCs.	Capital cost	$900,207
			PW quarterly monitoring (yrs 1-2)	$251,276
			PW annual monitoring (yrs 3-20)	$707,947
			Total present value	**$1,859,430**
	Groundwater monitoring	Long-term groundwater monitoring and reporting to evaluate: -Effectiveness of the ISCO injections -Potential impacts to surface water -Progress of natural attenuation over time -Potential migration to the deep aquifer		
	LUCs	LUCs to prevent exposure to groundwater.	**Timeframe**	**20 years**
5 – Air Sparging / LUCs	Air Sparging	Injection of air to induce mass transfer (stripping) of VOCs from groundwater and/or aerobic biodegradation.	Capital cost	$690,255
			PW annual O&M (yrs 1-3)	$598,991
			PW annual monitoring (yrs 4-20)	$650,664
			Total present value	**$1,939,910**
	Groundwater monitoring	Long-term groundwater monitoring and reporting to evaluate: -Effectiveness of the air sparging -Potential impacts to surface water -Progress of natural attenuation over time -Potential migration to the deep aquifer		
	LUCs	LUCs to prevent exposure to groundwater.	**Timeframe**	**20 years**

The No Action alternative does not protect human health and the environment, but is presented as a baseline for comparison purposes. With the exception of the No Action alternative, the common elements of the remedial alternatives are groundwater monitoring and reporting until all COCs have achieved their remediation goals for four consecutive sampling events and LUCs until COC concentrations in groundwater are reduced to levels that allow for unlimited use and unrestricted exposure. The most distinguishing feature of the alternatives is the expected timeframe to achieve RAOs. The timeframe for the active treatment alternatives (Alternatives 3 (enhanced reductive dechlorination [ERD]), 4 (*in*-situ chemical oxidation [ISCO]), and 5 (Air Sparging)) is projected to be about 20 years whereas monitored natural attenuation (MNA) is expected to take at least 30 years.

2.8.2 Comparative Analysis of Alternatives

A comparative analysis of alternatives with respect to the **nine evaluation criteria** was completed and is provided below. Table 7 presents the relative ranking of alternatives.

TABLE 7
Relative Ranking of Alternatives

CERCLA Criteria	Alternatives				
	No Action (1)	MNA (2)	ERD (3)	ISCO (4)	Air Sparging (5)
Threshold Criteria					
Protection of human health and the environment	❍	⭘	●	●	●
Compliance with ARARs	❍	⭘	●	●	●
Primary Balancing Criteria					
Long-term effectiveness and permanence	❍	⭘	⭘	⭘	●
Reduction in toxicity, mobility, or volume through treatment	❍	⭘	●	●	●
Short-term effectiveness	❍	⭘	⭘	⭘	●
Implementability	●	●	⭘	⭘	●
Present Cost	$0	$1.1 M	$2.5 M	$1.9 M	$1.9 M
Modifying Criteria					
State Acceptance	❍	⭘	●	●	●
Community Acceptance	NC	NC	NC	NC	NC

Ranking: ● High ⭘ Moderate ❍ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

NC = No significant comments were received from Community Members

Threshold Criteria

Overall Protection of Human Health and the Environment. Alternatives 2 (MNA), 3 (ERD), 4 (ISCO), and 5 (Air Sparging) are all protective of human health and the environment. Alternative 2 is considered to be less protective than Alternatives 3, 4, and 5 because it relies on natural degradation, which adds a higher degree of uncertainty for the rate of contaminant reduction and length of time to achieve RAOs. Alternatives 3, 4, and 5 are similar in protectiveness because they each employ an active treatment to reduce chemical concentrations. Monitoring will be conducted, and LUCs will provide adequate protection of human health and the environmental by controlling exposure to groundwater until the RAOs are achieved.

Compliance with ARARs. The timeframe for compliance with Chemical-specific ARARs will vary with different remedial alternatives. Location-specific ARARS remain the same for each alternative and Action-specific ARARs may vary to some extent with the different remedial alternatives. Alternatives 2, 3, 4, and 5 are expected to comply with all ARARs. Alternative 2 will have a longer timeframe associated with meeting the ARARs because it relies on natural degradation, whereas Alternatives 3, 4, and 5 employ active treatment and will therefore meet the ARARs in a shorter timeframe than Alternative 2.

Primary Balancing Criteria

Long-term Effectiveness and Permanence. Once RAOs have been achieved, Alternatives 2, 3, 4, and 5 are expected to have residual risks of approximately the same magnitude. Because Alternative 2 is dependent on the **rate of natural biodegradation**, it may not be effective for more than 30 years whereas the active treatment component of Alternatives 3, 4, and 5 is intended to reduce groundwater contaminant concentration to levels below regulatory limits in a shorter timeframe (less than 20 years), although "rebound" is a potential issue with any injection or air sparging scenario. Alternative 5 is expected to provide the greatest degree of long-term effectiveness if rebound occurs because a permanent horizontal well will be installed for air sparging and would allow for cost-effective implementation of subsequent treatment if RAOs are not achieved.

Reduction in Toxicity, Mobility, or Volume. Alternatives 3, 4, and 5 will reduce the toxicity, mobility, and volume through active treatment, which is the statutory preference. Although Alternative 2 is not considered active treatment, the natural reduction of contaminant concentrations through a variety of physical, chemical, or biological activities is expected over time.

Short-term Effectiveness. Alternative 2 does not rely on an active treatment, and there is no implementation time or impacts to the community; however, there is a higher potential for impacts to Brinson Creek based on the extended timeframe to achieve RAOs. The timeframe to implement Alternatives 3, 4, and 5 and any impacts to the community or environment are similar because treatments rely on injection technology. Alternatives 3, 4, and 5 involve active treatment to reduce contaminant mass, resulting in less potential for impacts to Brinson Creek.

Alternative 4 has a higher short-term risk to site workers during implementation because it involves handling of and potential exposure to oxidants and strong corrosive chemicals. During implementation of Alternative 5, there is a potential short-term risk from

contaminant volatilization; however, modeling suggests that no exposures would exceed risk-based criteria. Risks to site workers can be addressed through the use of appropriate personal protective equipment and air monitoring.

The horizontal well component of Alternative 5 has only two surface disturbance areas, resulting in minimal impacts to the Base training areas, in comparison to the multiple injection components of Alternatives 3 and 4.

Implementability. Alternatives 3, 4, and 5 can be implemented using materials and services readily available. However, subsurface injections rely heavily on the ability to effectively distribute reagents uniformly in the subsurface. Air sparging (Alternative 5) using a horizontal well has been successfully implemented in the past at MCB Camp Lejeune whereas injection of ERD (Alternative 3) and ISCO (Alternative 4) have been less effective at some sites due to challenges associated with substrate distribution. In addition, ISCO would require extra health and safety precautions for the handling of both the oxidant and the activator.

Cost. Table 6 summarizes the capital costs, as well as long-term O&M costs for the alternatives. **Projected capital costs** for alternatives using active remediation processes (Alternatives 3, 4, and 5) are greater than alternatives for no action or MNA, (Alternatives 1 and 2, respectively). The highest capital cost is $2.5 million for Alternative 3, followed by $1.9 million for Alternatives 4 and 5. Both technologies are expected to require 20 years to achieve the ARARs, while Alternatives 1 and 2 are expected to require more than 30 years to achieve the ARARs. Alternative 2 has high capital costs ($1.1 million) because several new monitoring wells will be installed to track contaminant movement and degradation processes.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. NCDENR, as the designated state support agency in North Carolina, concurs with the Selected Remedy (Appendix A).

Community Acceptance. The public meeting was held on April 21, 2009, to present the Proposed Remedial Action Plan (PRAP) and answer community questions regarding the proposed remedial action at Site 35. There were no concerns raised at the meeting, and the questions were general inquiries for information purposes only. No comments were received from the public. Detailed information on the public meeting is provided in the Responsiveness Summary (Section 3) of this ROD.

2.9 Selected Remedy

Alternative 5, Air Sparging using a Horizontal Well, Monitoring of the Natural Degradation of COCs, and LUCs is the Selected Remedy to address groundwater contamination at Site 35.

2.9.1 Summary of Rationale for the Selected Remedy

Alternative 5 was chosen over Alternatives 2, 3, and 4 because it has been effective at other IR sites with similar subsurface geology at MCB Camp Lejeune. Air sparging using a horizontal well would allow for subsequent treatment if RAOs are not achieved in a

reasonable timeframe because, after the initial installation of the horizontal well and treatment system, it would require minimal restart costs if rebound occurs and could potentially be used for injection of alternative chemicals or gases. Additionally, the single horizontal well configuration results in fewer surface impacts to the active training area than alternatives with several vertical injection wells. Finally, the Selected Remedy meets the statutory preference for active treatment with lower or similar costs to comparable alternatives.

2.9.2 Description of the Selected Remedy

The Selected Remedy includes injection of air in an area with the highest TCE concentration, LTM for MNA in areas outside the active treatment area to ensure that natural degradation is occurring, and LUCs to prevent use of the contaminated groundwater until the concentrations of hazardous substances are at such levels as to allow for unrestricted use and unlimited exposure. The active treatment area, proposed monitoring wells, and proposed location of the air sparge well is shown in Figure 5.

The proposed air sparge treatment includes the installation of a horizontal well with a screened interval of 470 ft at a depth of 65 ft bgs and 300 ft of riser at the proximal and distal ends. Air is injected through the horizontal well promoting mass transfer of CVOCs and/or aerobic biological degradation. Two-phase gas flow in saturated porous media, driven by buoyancy, occurs as a complex and nonuniform series of finger-like channels, the path of which is strongly influenced by subsurface heterogeneity. Based on air sparge systems installed at Sites 86 and 89, the radius of influence for a horizontal air sparge system installed at Site 35 is expected to be approximately 50 to 100 ft. The system will be operated until protectiveness of Brinson Creek is demonstrated through fate and transport modeling or for up to 3 years.

Groundwater monitoring will be conducted on a quarterly basis during the operation of the air sparge system and then on an annual basis thereafter. Samples collected from the monitoring wells will be analyzed for COCs. Although MNA was evaluated further in the FS, it is not considered a stand-alone remedial alternative because it does not prevent human exposure to COCs in groundwater. **Predictive modeling,** supported by empirical data, was conducted as part of the FS to evaluate the time for groundwater impacts to achieve NCGWQS via natural attenuation and the potential for CVOC concentrations to reach Brinson Creek. Results indicated that surface water standards for COCs will not be exceeded and that sitewide COC concentrations will fall below NCGWQS within 30 to 40 years (with no remedial action). Because of the low concentrations of COCs in areas outside the active treatment zone and evidence that **natural biodegradation is occurring** at Site 35, MNA is an effective remedy component in conjunction with air sparging and LUCs.

LUCs including, but not limited to, land use restrictions in the Base Master Plan, Notice of Contaminated Site, and administrative procedures to prohibit unauthorized activities will be implemented as part of the remedy to prevent exposure to the residual contamination on the site that exceeds the remediation goals. The Navy and MCB Camp Lejeune are responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although, the Navy and MCB Camp Lejeune may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy and MCB Camp Lejeune shall retain ultimate responsibility for the remedy

integrity. The LUCs will be implemented and maintained by the Navy and MCB Camp Lejeune until the concentrations of hazardous substances in the groundwater are at such levels to allow for unlimited use and unrestricted exposure. The LUC performance objectives include:

- To prohibit human consumption of groundwater from the surficial and Castle Hayne aquifers underlying Site 35; and
- To maintain the integrity of any existing or future monitoring or remediation system at the site such as the monitoring wells and horizontal air sparge system.

The specific types of LUCs which will be implemented include:

1. Incorporating land and groundwater use prohibitions into the MCB Camp Lejeune Base Master Plan;
2. Recording a Notice of Contaminated Site filed in Onslow County real property records per North Carolina General Statutes (NCGS) 143B-279.9 and 143B-279.10;
3. Maintain the integrity of any current or future remedial or monitoring system such as conducting site inspections to verify the integrity of the monitoring wells and horizontal air sparge system, and to verify compliance with use restrictions; and
4. Deed and/or lease restrictions in the event of transfer for any portion of Site 35.

The Navy shall prepare, in accordance with USEPA guidance, and submit to the USEPA and NCDENR, a Remedial Design (RD) containing LUC implementation and maintenance actions, including periodic inspections, within 90 days of the ROD signature, for review and approval. The Navy/MCB Camp Lejeune are responsible for implementing, maintaining, inspecting, reporting on, and enforcing the LUCs described in this ROD in accordance with the ROD and the approved RD.

FIGURE 5
Proposed Air Sparge Horizontal Well Layout

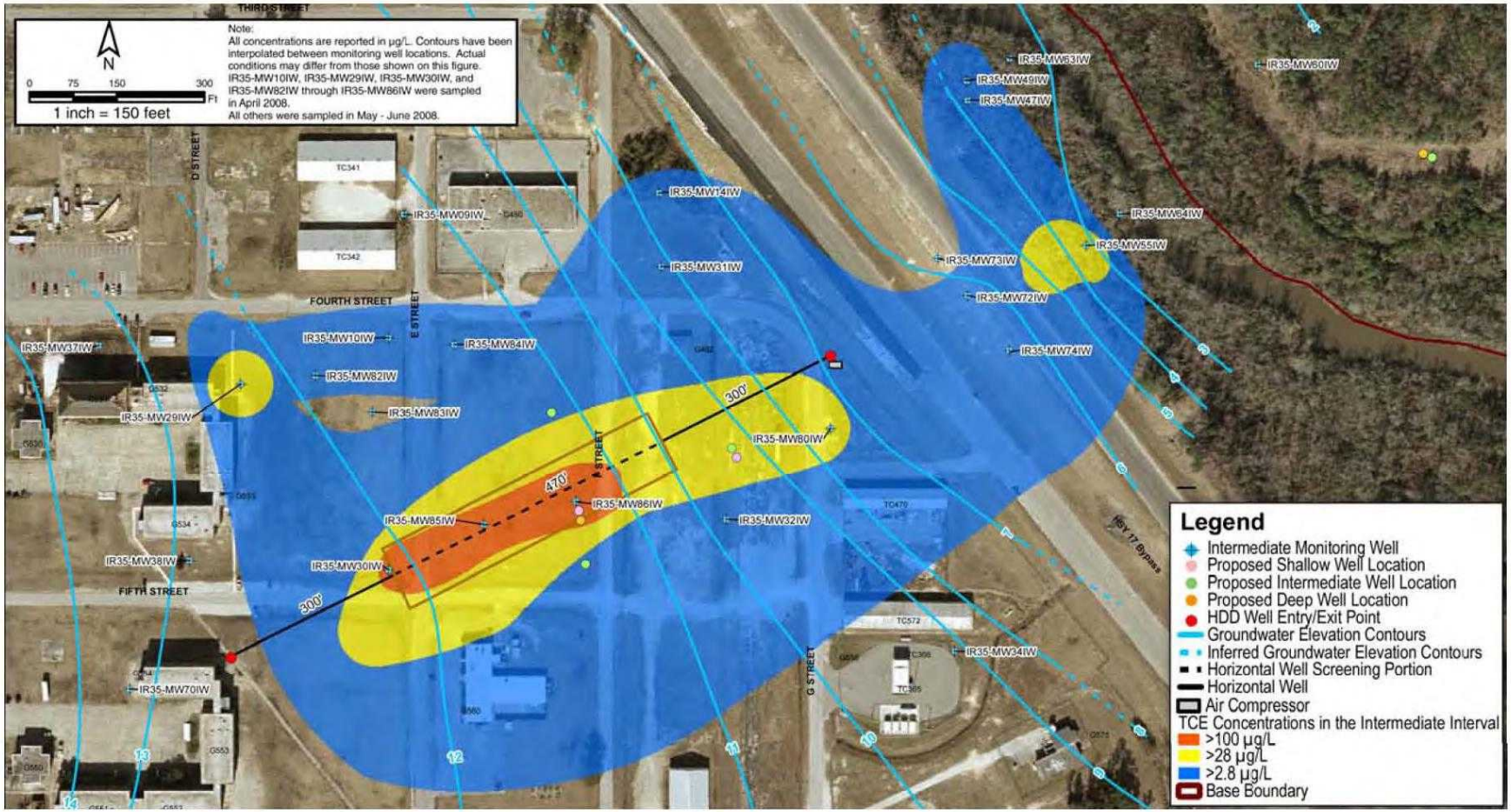
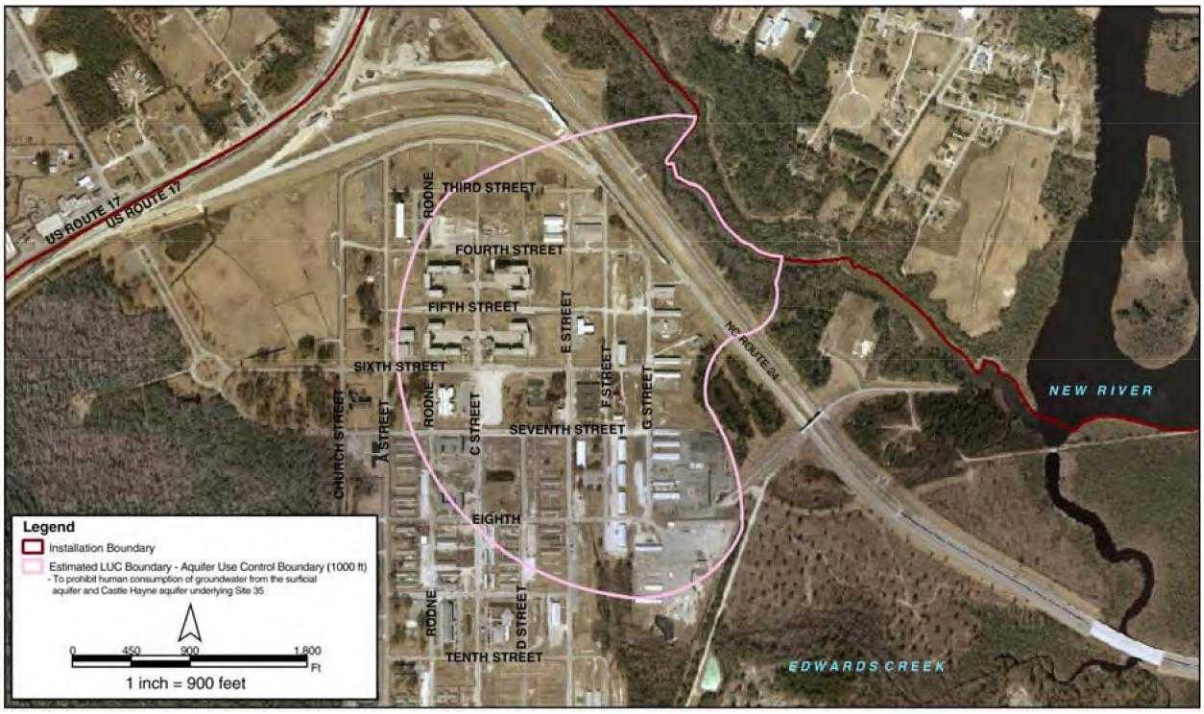


Figure 6 shows the approximate LUC boundaries at Site 35.

FIGURE 6
Estimated LUC Boundary



2.9.3 Expected Outcomes of the Selected Remedy

Although current land uses are expected to continue at Site 35 and there is no other planned land use in the foreseeable future, unlimited use and unrestricted exposure will be available as a result of the Selected Remedy. Exposure will be controlled through LUCs until groundwater VOC concentrations are reduced to the remediation goals. The air sparge system will be operated for up to 3 years. System effectiveness will be evaluated annually by comparison of current concentrations of COCs in treatment area monitoring wells to pretreatment concentrations and the remediation goals. One of three conditions will be met to shut down the air sparge system: a reduction of COC concentrations of 75 percent in source area wells, COC reductions in source area wells demonstrating an asymptotic trend prior to achieving the target 75 percent reduction, and protectiveness of Brinson Creek is demonstrated through fate and transport modeling or operation of the system for 3 years. If the target of 75 percent reduction of COCs in source area wells is not met at the time of system shutdown, the Navy and Marine Corps, in partnership with USEPA and the State, will evaluate whether additional remedial actions other than MNA should be implemented.

In accordance with the LUC objectives, groundwater use will be restricted to monitoring or remedial purposes. LTM will be conducted until each COC is at or below it respective remediation goal for four consecutive monitoring events. The Navy and Marine Corps, in partnership with USEPA and the State, will evaluate the discontinuation of monitoring of individual COCs that have met the remediation goals after four rounds based on site

conditions. The results of LTM will be documented in an annual monitoring report. When all COCs have achieved their goals for four consecutive sampling events, site closure will be initiated.

The existing vertical air sparge trench implemented as part of the Interim ROD for surficial groundwater will be discontinued because it was intended for only a portion of the shallow groundwater plume, has demonstrated limited effectiveness, and the Selected Remedy in this ROD is to address the entire shallow and intermediate groundwater plume.

2.9.4 Statutory Determinations

Remedial actions undertaken at NPL sites must meet the statutory requirements of Section 121 of CERCLA and thereby achieve adequate protection of human health and the environment, comply with ARARs of both federal and state laws and regulations, be cost-effective, and use, to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element. The following discussion summarizes the statutory requirements that are met by the Selected Remedy.

Protection of Human Health and the Environment

Because there is unacceptable risk to human health, due to the contaminated groundwater at this site that is considered a potential drinking water source, a remedial action is required to restore the groundwater to meet drinking water standards (i.e., MCLs or NCGWQS). Although there is no risk based on current land use, the Selected Remedy will protect human health and the environment by reducing site risks through groundwater treatment and the implementation of LUCs to eliminate the threat of exposure to the COCs via ingestion of impacted groundwater.

Compliance with ARARs and To-Be-Considered Criteria

Section 121(d) of CERCLA, as amended, specifies, in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or obtain a waiver. See also 40 C.F.R. § 300.430(f)(1)(ii)(B). ARARs include only federal and state environmental or facility citing laws/regulations and do not include occupational safety or worker protection requirements. Compliance with OSHA standards is required by 40 C.F.R. § 300.150 and therefore the CERCLA requirement for compliance with or wavier of ARARs does not apply to OSHA standards. In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release. The "to-be-considered" (TBC) category consists of advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. See 40 C.F.R. § 300.400(g)(3). In accordance with 40 C.F.R. § 300.400(g), Navy, EPA and NCDENR have identified the ARARs and TBCs for the selected remedy. Appendix B lists respectively the Chemical-, Location- and Action-Specific ARARs/TBCs for the Selected Remedy. The Selected Remedy will meet all identified ARARs.

Cost-Effectiveness

The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. The following definition was used to determine cost-effectiveness, "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness (NCP §300.430(f)(1)(ii)(D)". This analysis was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria. The costs are proportional to overall effectiveness by achieving long-term effectiveness and permanence within a reasonable timeframe.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at Site 35. Because long-term effectiveness and permanence along with reduced toxicity and volume are achieved in the shortest timeframe with the Selected Remedy, the Navy, MCB Camp Lejeune, USEPA, and NCDENR determined that the Selected Remedy provides the best balance of tradeoffs in terms of the balancing criteria, while also considering the statutory preference for treatment as a principal element and considering state and community acceptance.

Preference for Treatment as a Principal Element

The Selected Remedy uses treatment as a principal element, and therefore satisfies the statutory preference for treatment.

Five-Year Review Requirements

This remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure; therefore in accordance with CERCLA Section 121(c) and the NCP at 40 CFR300.430 (f)(4)(ii) a statutory review will be conducted by the Navy within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. If the remedy is determined not to be protective of human health and the environment because, for example, LUCs have failed or treatment is unsuccessful, then additional remedial actions would be evaluated by the FFA parties and the Navy may be required to undertake additional remedial action.

2.10 Community Participation

The Navy, MCB Camp Lejeune, USEPA, and NCDENR provide information regarding the cleanup of MCB Camp Lejeune to the public through the community relations program, which includes a Restoration Advisory Board (RAB), public meetings, the Administrative Record file for the site, and announcements published in local newspapers. RAB meetings continue to be held to provide an information exchange among community members, the Navy, MCB Camp Lejeune, USEPA, and NCDENR. These meetings are open to the public and are held quarterly.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period from April 21, 2009, through May 20, 2009, for the PRAP for Site 35. A public meeting to present the PRAP was held on April 21, 2009, at the Carolina Coastal Community College.

Public notice of the meeting and availability of documents were placed in *The Jacksonville Daily News* (April 8 and 19, 2009), *The Globe* (April 9 and 16, 2009), and *Roto Vue* (April 15, 2009) newspapers.

The Administrative Record, Community Relations Plan, IRP fact sheets, and final technical reports concerning Site 35 can be obtained from the IRP web site:

http://public.lantops-ir.org/sites/public/lejeune/Site35_73Prap.aspx

Internet access is available to the public at the following location:

Onslow County Public Library
58 Doris Avenue East
Jacksonville, North Carolina 28540
(910) 455-7350

2.11 Documentation of Significant Changes

The PRAP for Site 35 was released for public comment on April 21, 2009. No comments were received during the public meeting or comment period. It was determined that no significant changes to the remedy, as originally identified in the PRAP were necessary or appropriate.

3 Responsiveness Summary

The participants in the Public Meeting held on April 21, 2009, included representatives of the Navy, MCB Camp Lejeune, USEPA, and NCDENR. Two community members attended the meeting. Questions received during the public meeting were general inquiries and are described in the public meeting minutes provided in the Administrative Record. There were no comments received at the public meeting requiring amendment to the PRAP; and no additional written comments, concerns, or questions were received from community members during the public comment period.

Appendix A
NCDENR Concurrence Letter

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Waste Management

Beverly Eaves Perdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

August 10, 2009

NAVFAC Mid-Atlantic
Attn: Dave Cleland Code: OPQE
USMC NC IPT, EV Business Line
6506 Hampton Blvd
Norfolk, VA 23508

RE: Concurrence with the August 2009 revised Draft Final Record of Decisions for OU# 10, Site 35 at MCB Camp Lejeune, NC, Soil and Groundwater
Camp Lejeune, NC6170022580
Jacksonville, Onslow County, North Carolina

Dear Mr. Cleland:

The NC Superfund Section has received and reviewed the revised Draft Final Record of Decision (ROD) for Ou#10, Site 35 at MCB, Camp Lejeune dated August 2009 and concurs that the selected remedy is protective of human health and the environment.

The State's concurrence is based solely on the information contained in the Revised Draft Final ROD dated August 2009 for OU#10, Site 35. Should we receive additional information that significantly affects the conclusions of the ROD, we may modify or withdraw this concurrence with written notice to the Naval Facilities Engineering Command for Camp Lejeune and the EPA Region IV.
If you have any questions or comments, please contact me, at (919) 508 8464 or email **David.Lown@ncmail.net**

Sincerely,

David J. Lown, LG, PE
Head, Federal Remediation Branch
Superfund Section

Cc: Randy McElveen, NC Superfund Section
Bob Lowder, EMD/IR
Gena Townsend, USEPA

Appendix B
ARARs and TBC

TABLE B-1

Federal and North Carolina Chemical-Specific ARARs			
Media	**Requirement**	**Prerequisite**	**Citation**
Classification of contaminated groundwater	Groundwaters in the state naturally containing 250 mg/L or less of chloride are *classified as GA* under 15A NCAC 02L .0201(1)	Groundwaters located within the boundaries or under the extraterritorial jurisdiction of the State of North Carolina **- Applicable**	15A NCAC 02L .0302(1)
	Groundwaters in the state naturally containing greater than 250 mg/L of chloride are *classified as GSA* under 15A NCAC 02L .0201(2)		15A NCAC 02L .0302(2)
Restoration of contaminated groundwater	Shall not exceed the groundwater quality standards[1] for contaminants specified in Paragraphs (g) or (h) for the site related contaminants of concern. · Benzene (1 µg/L) · 1,1,2,2-PCA (0.17 µg/L) · PCE (0.7 µg/L) · cis-1,2-DCE (70 µg/L) · 1,1-DCE (70 µg/L) · TCE (2.8 µg/L) · Vinyl Chloride (0.015 µg/L)	Class GA or GSA groundwaters with contaminant(s) concentrations exceeding standards listed in 15A NCAC 02L .0202 **– Relevant and Appropriate**	15A NCAC 02L .0202(a) and (b)
	Shall not exceed the Safe Drinking Water Act National Revised Primary Drinking Water Regulations: maximum contaminant levels (MCLs) for organic contaminants specified in 40 CFR 141.61(a).	Groundwaters classified as GA or GSA which are an existing or potential source of drinking water **- Relevant and Appropriate**	40 CFR 141.61(a) 15A NCAC 18C .1517
Protection of adjacent surface water body	Monitor and undertake management practices for sources of pollution such that water quality standards and best usage of receiving waters and all downstream waters will not be impaired.	Indirect discharges of waste or other source of water pollution into Tidal Salt Waters classified as Class SC **- Relevant and Appropriate**	15A NCAC 02B .0203
	The concentrations of toxic substances, either alone or in combination with other wastes, in surface waters shall not render waters injurious to aquatic life or wildlife, recreational activities, public health, or impair the waters for any designated uses.	Nonpoint discharges into Tidal Salt Waters classified as Class SC **- Relevant and Appropriate**	15A NCAC 02B .0208

TABLE B-1

Federal and North Carolina Chemical-Specific ARARs			
Media	**Requirement**	**Prerequisite**	**Citation**
Protection of adjacent surface water body (cont.)	Toxic substances: shall not exceed the numerical quality standards (maximum permissible levels) to protect human health from carcinogens through consumption of fish (and shellfish). · Benzene (51 µg/L) · 1,1,2,2-PCA · PCE · cis-1,2-DCE · 1,1-DCE · TCE (30 µg/L) · Vinyl Chloride (2.4 µg/L)	Nonpoint discharges (containing toxic substances which are carcinogens) into Tidal Salt Waters classified as Class SC **- Relevant and Appropriate**	15A NCAC 02B .0208(a)(2)B)
	Shall not exceed 25 NTU turbidity level (unless due to natural background conditions). Compliance with this standard can be met when land management activities employ Best Management Practices [as defined by Rule .0202 of this Section].	Nonpoint discharges into Tidal Salt Waters classified as Class SC in 15A NCAC 02B .0220 **- Relevant and Appropriate**	15A NCAC 02B .0220(3)(l)
	Toxic substances: shall not exceed the numerical quality standards (maximum permissible levels) provided in subparagraphs (i) through (xi) to protect aquatic life.		15A NCAC 02B .0220(m)

Notes:

[1] Groundwater quality standards established on the basis of a National secondary drinking water standards are not utilized as remediation goals since these are based on taste, odor, and other considerations unrelated to human health.

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC			
Action	**Requirement**	**Prerequisite**	**Citation**
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)			
Managing storm water runoff from land-disturbing activities	Shall install erosion and sedimentation control devices and practices sufficient to retain the sediment generated by the land-disturbing activity within the boundaries of the tract during construction.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land **– Relevant and Appropriate**	N.C.G.S. Ch.113A-57(3)
	Shall plant or otherwise provide permanent ground cover sufficient to restrain erosion after completion of construction.		N.C.G.S. Ch.113A-57(3)
	Shall take all reasonable measures to protect all public and private property from damage caused by such activities.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land **– Relevant and Appropriate**	15A NCAC 4B.0105
	Erosion and sedimentation control plan must address the following basic control objectives:		15A NCAC 4B.0106
	(1) Identify areas subject to severe erosion, and off-site areas especially vulnerable to damage from erosion and sedimentation.		
	(2) Limit the size of the area exposed at any one time.		
	(3) Limit exposure to the shortest feasible time.		
	(4) Control surface water run-off originating upgrade of exposed areas .		
	(5) Plan and conduct land-disturbing activity so as to prevent off-site sedimentation damage.		
	(6) Include measures to control velocity of storm water runoff to the point of discharge.		
	Erosion and sedimentation control measures, structures, and devices shall be planned, designed, and constructed to provide protection from the run-off of 10-year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land **- Applicable**	15A NCAC 4B.0108
	Shall conduct activity so that the post-construction velocity of the 10-year storm run-off in the receiving watercourse to the discharge point does not exceed the parameters provided in this Rule.		15A NCAC 4B.0109
	Shall install and maintain all temporary and permanent erosion and sedimentation control measures.		15A NCAC 4B.0113

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC			
Action	**Requirement**	**Prerequisite**	**Citation**
Managing fugitive dust emissions	Shall not cause or allow fugitive dust emissions to cause or contribute to substantive complaints, or visible emissions in excess of that allowed under paragraph (e) of this Rule.	Activities within facility boundary that will generate fugitive dust emissions **- Relevant and Appropriate**	15A NCAC 02D .0540(c)
	Implement methods (e.g. wetting dry soils) to control dust emissions that could travel beyond the facility boundary.		15A NCAC 02D .0540(g)
Monitoring Well Installation, Operation, and Abandonment			
Construction of groundwater monitoring well(s)	No well shall be located, constructed, operated, or repaired in any manner that may adversely impact the quality of groundwater.	Installation of wells (including temporary) other than for water supply **- Applicable**	15A NCAC 02C .0108(a)
	Shall be located, designed, constructed, operated and abandoned with materials and by methods which are compatible with the chemical and physical properties of the contaminants involved, specific site conditions, and specific subsurface conditions.		15A NCAC 02C .0108(c)
	Must comply with general requirements for construction of a well as provided in 15A NCAC 02C .0108(c)(1) through (12)		15A NCAC 02C .0108(c)
	Shall be constructed in such a manner as to preclude the vertical migration of contaminants with and along borehole channel.		15A NCAC 02C .0108(f)
Implementation of groundwater monitoring system	Shall be constructed in a manner that will not result in contamination of adjacent groundwaters of a higher quality.	Installation of monitoring system to evaluate effects of any actions taken to restore groundwater quality, as well as the efficacy of treatment **- Applicable**	15A NCAC 02L .0110 (b)
Maintenance of groundwater monitoring well(s)	Every well shall be maintained by the owner in a condition whereby it will conserve and protect groundwater resources, and whereby it will not be a source or channel of contamination or pollution to the water supply or any aquifer.	Installation of wells (including temporary wells) other than for water supply **- Applicable**	15A NCAC 02C .0112(a)
	Broken, punctured, or otherwise defective or unserviceable casing, screens, fixtures, seals, or any part of the well head shall be repaired or replaced, or the well shall be abandoned pursuant to 15A NCAC 02C .0113		15A NCAC 02C .0112(c)
	All materials used in the maintenance, replacement, or repair of any well shall meet the requirements for new installation.		15A NCAC 02C .0112(b)
Abandonment of groundwater monitoring well(s)	Shall be abandoned in accordance with the requirements of 15A NCAC 02C .0113(b)(1) and (2)	Permanent abandonment of wells (including temporary wells) other than for water supply **- Applicable**	15A NCAC 02C .0113(b)

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC			
Action	**Requirement**	**Prerequisite**	**Citation**
Underground Injection Well Installation, Operation, and Abandonment			
Construction of injection well(s) for *in-situ* treatment of groundwater	Construction, use or operation may be allowed provided the injected material does not contain any waste or any substance of a composition and concentration such that, if it were discharged to the land or waters of the state, would create a threat to human health or would otherwise render those waters unsuitable for their intended usage.	Installation of Class 5 underground injection well (Type I – *In-situ* Groundwater Remediation Well) - **Applicable**	15A NCAC 02C .0209(e)(3)
	Shall provide information on the injection well, procedure, and material otherwise required for obtaining a permit in the Remedial Design or Remedial Action Work Plan.		15A NCAC 02C .0211(d)(3)
Location of injection well(s) for *in-situ* treatment of groundwater	Shall not be located in an area generally subject to flooding. Areas which are generally subject to flooding include those with concave slope, alluvial or colluvial soils, gullies, depressions, and drainage ways.	Installation of Class 5 underground injection well (Type I – *In-situ* Groundwater Remediation Well) - **Applicable**	15A NCAC 02C .0213(a)(1)
	Shall not be located at a point where the injectant would degrade the existing quality of the groundwater in the water-bearing unit into which the injectant is being released.	Installation of Class 5 underground injection well (Type I – *In-situ* Groundwater Remediation Well) where the concentration of any component of the injectant *exceeds* the groundwater quality standards specified in 15A NCAC 2L .0202 **Applicable**	15A NCAC 02C .0213(a)(2)(A)(i)
	Shall not be located at a point where the injectant would result in a contravention of any of the aforementioned groundwater quality standards in the water-bearing unit into which the injectant is being released.	Installation of Class 5 underground injection well (Type I – *In-situ* Groundwater Remediation Well) where the concentration of any component of the injectant *is less than* the groundwater quality standards specified in 15A NCAC 2L .0202 - **Applicable**	15A NCAC 02C .0213(a)(2)(B)
Construction of injection well(s) for *in-situ* treatment of groundwater	Shall follow the procedures, methods, specified materials, and requirements specified in the subparagraphs (A) through (G) of this Rule for Drilling, Casing, Screens and Testing.	Installation of Class 5 underground injection well (Type I – *In-situ* Groundwater Remediation Well) - **Applicable**	15A NCAC 02C .0213(c)(1) through (4)
	Shall follow the procedures, methods, specified materials, and requirements specified in the paragraphs (1) through (8) of this Rule for Grouting and Sand-and-Gravel Packing.		15A NCAC 02C .0213(d)
Operating an injection well(s) for *in-situ* treatment of groundwater	Pressure at the well head shall be limited to a maximum which will ensure the pressure in the injection zone does not initiate new fractures or propagate existing fractures in the injection zone, initiate fractures in the confining zone, or cause the migration of injected or formation fluids outside the injection zone or area.		15A NCAC 02C .0213(e)

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC			
Action	**Requirement**	**Prerequisite**	**Citation**
Abandonment of injection well(s) for *in-situ* treatment of groundwater	Shall be abandoned in accordance with the requirements of subparagraphs (1) and (2) of 15A NCAC 02C .0114.	Installation of Class 5 underground injection well (Type I – *In-situ* Groundwater Remediation Well *or* Type 5L Closed-Loop Groundwater Remediation Well), including exploratory or test wells - **Applicable**	15A NCAC 02C .0214
Control of Diffuse VOC Emissions from Groundwater Treatment			
Emissions of VOCs from groundwater treatment (e.g., sparging system)	Shall not emit any of the toxic air pollutants listed in the table of the Rule in such quantities that may cause or contribute beyond the premises (adjacent property boundary) to any significant ambient air concentration that may adversely affect human health.	Emissions of toxic air pollutants (e.g., VOCs) from facility into the ambient air - **Applicable**	15A NCAC 02D .1104
	Shall install and operate reasonable available control technology to limit emissions of VOCs.	Air emissions of VOCs from facilities where there is no other applicable emissions control rule - **Relevant and Appropriate**	15A NCAC 02D .0951(c)
	One of the applicable test methods in Appendix M in 40 CFR part 51 or Appendix A in 40 CFR Part 60 shall be used to determine compliance with VOC emission standards.	VOC emission source not covered by 15A NCAC 02D.2613(b) through (e) - **Relevant and Appropriate**	15A NCAC 02D .2613(g)
	Control emissions by meeting limitations and work practice standards reflecting application of the maximum achievable control technology. Periodic inspection of equipment and monitoring are required for the life of the remediation.	Air emissions of organic Hazardous Air Pollutants (e.g.,VOCs) from site remediation - **Relevant and Appropriate**	40 CFR 63 Subpart GGGGG, NESHAPS for Site Remediation
Waste Characterization and Storage — Primary Wastes (i.e., excavated contaminated soils)			
Characterization of solid waste (e.g., well soil cuttings)	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4(b); and	Generation of solid waste as defined in 40 CFR 261.2 and which is not excluded under 40 CFR 261.4(a) - **Applicable**	40 CFR 262.11(a)
	Must determine if waste is listed under 40 CFR Part 261; or		40 CFR 262.11(b)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.		40 CFR 262.11(c)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous - **Applicable**	40 CFR 262.11(d)

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC

Action	Requirement	Prerequisite	Citation
Storage of solid waste	All solid waste shall be stored in such a manner as to prevent the creation of a nuisance, insanitary conditions, or a potential public health hazard.	Generation of solid waste which is determined *not* to be hazardous **- Relevant and Appropriate**	15A NCAC 13B .0104(f)
	Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. Containers that are broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.		15A NCAC 13B .0104(e)
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA-hazardous waste for storage, treatment or disposal **- Applicable**	40 CFR 264.13(a)(1)
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal **- Applicable**	40 CFR 268.9(a)
	Must determine if the waste is restricted from land disposal under 40 CFR 268 *et seq.* by testing in accordance with prescribed methods or use of generator knowledge of waste.		40 CFR 268.7
	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 CFR 268.40 *et. seq.*		40 CFR 268.9(a)
Temporary storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that: waste is placed in containers that comply with 40 CFR 265.171-173; and	Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10 **- Applicable**	40 CFR 262.34(a) 40 CFR 262.34(a)(1)(i)
	the date upon which accumulation begins is clearly marked and visible for inspection on each container		40 CFR 262.34(a)(2)
	container is marked with the words “hazardous waste”; or		40 CFR 264.34(a)(3)
	container may be marked with other words that identify the contents.	Accumulation of 55 gal. or less of RCRA hazardous waste at or near any point of generation **- Applicable**	40 CFR 262.34(c)(1)

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC

Action	Requirement	Prerequisite	Citation
Use and management of hazardous waste in containers	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers - **Applicable**	40 CFR 265.171
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired.		40 CFR 265.172
	Keep containers closed during storage, except to add/remove waste.		40 CFR 265.173(a)
	Open, handle and store containers in a manner that will not cause containers to rupture or leak.		40 CFR 265.173(b)
Waste treatment and disposal—primary wastes (excavated contaminated soils)			
Disposal of solid waste	Shall ensure that waste is disposed of at a site or facility which is permitted to receive the waste.	Generation of solid waste intended for off-site disposal - **Relevant and Appropriate**	15A NCAC 13B .0106(b)
Disposal of RCRA-hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste - **Applicable**	40 CFR 268.40(a)
	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or Must be treated according to the UTSs [specified in 40 CFR 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils - **Applicable**	40 CFR 268.49(b)
Transportation of Wastes			
Transportation of hazardous waste on-site	The generator manifesting requirements of 40 CFR 262.20-262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way - **Applicable**	40 CFR 262.20(f)

TABLE B-2

Federal and North Carolina Action-Specific ARARs and TBC

Action	Requirement	Prerequisite	Citation
Transportation of hazardous waste off-site	Must comply with the generator requirements of 40 CFR 262.20-23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding, Sect. 262.40, 262.41(a) for record keeping requirements, and Sect. 262.12 to obtain EPA ID number.	Off-site transportation of RCRA-hazardous waste - **Applicable**	40 CFR 262.10(h)
	Must comply with the requirements of 40 CFR 263.11-263.31.	Transportation of hazardous waste within the United States requiring a manifest - **Applicable**	40 CFR 263.10(a)
	A transporter who meets all applicable requirements of 49 CFR 171-179 and the requirements of 40 CFR 263.11 and 263.31 will be deemed in compliance with 40 CFR 263.		
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and DOT HMR at 49 CFR 171-180.	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material - **Applicable**	49 CFR 171.1(c)
Institutional Controls for Contamination Left in Place			
Notice of Contaminated Site	Prepare and certify by professional land surveyor a survey plat which identifies contaminated areas which shall be entitled "NOTICE OF CONTAMINATED SITE".	Contaminated site subject to current or future use restrictions included in a remedial action plan as provided in G.S. 143B-279.9(a) - **To-Be-Considered**	NCGS 143B-279.10(a)
	Notice shall include a legal description of the site that would be sufficient as a description in an instrument of conveyance and meet the requirements of NCGS 47-30 for maps and plans.		
	The Survey plat shall identify: • the location and dimensions of any disposal areas and areas of potential environmental concern with respect to permanently surveyed benchmarks; • the type location, and quantity of contamination known to exist on the site; and •any use restriction on the current or future use of the site.		NCGS 143B-279.10(a)(1)-(3)
	Notice (survey plat) shall be filed in the register of deeds office in the county which the site is located in the grantor index under the name of the owner.		NCGS 143B-279.10(b) and (c)
	The deed or other instrument of transfer shall contain in the description section, in no smaller type than used in the body of the deed or instrument, a statement that the property is a contaminated site and reference by book and page to the recordation of the Notice.	Contaminated site subject to current or future use restrictions as provided in G.S. 143B-279.9(a) that is to sold, leased, conveyed or transferred - **To-Be-Considered**	NCGS 143B-279.10(e)

TABLE B-3

Federal Location-Specific ARARs and TBC			
Location	**Requirement**	**Prerequisite**	**Citation**
Presence of floodplain designated as such on a map	Shall consider alternatives to avoid, to the extent possible adverse effects and incompatible development in the floodplain.	Federal actions that involve potential impacts to, or take place within, floodplains **- To-Be-Considered**	Executive Order 11988 Section 2(a)(2)

Appendix C
Acronyms and Abbreviations

Acronyms and Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
AST	aboveground storage tank
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
ActCOC	chemical of concern
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DD	Decision Document
DNAPL	dense nonaqueous phase liquid
ERA	Ecological Risk Assessment
ERD	enhanced reductive dechlorination
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft	foot/feet
HHRA	Human Health Risk Assessment
IRP	Installation Restoration Program
ISCO	*in-situ* chemical oxidation
LNAPL	light nonaqueous phase liquid
LTM	long-term monitoring
LUC	land use control
MCB	Marine Corps Base
MCL	maximum contaminant level
MNA	monitored natural attenuation
msl	mean sea level
NAIP	natural attenuation indicator parameters
NAPL	nonaqueous phase liquid
Navy	United States Navy
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NCSWQS	North Carolina Surface Water Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OU	operable unit
PCA	1,1,2,2-tetrachloroethane
PCE	tetrachloroethene
PRAP	Proposed Remedial Action Plan

QI	quotient index
RAB	Restoration Advisory Board
RAO	remedial action objective
RD	Remedial Design
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SGI	Supplemental Groundwater Investigation
SMP	Site Management Plan
TBC	to-be-considered
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound

References

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	several releases were reported	Section 2.1	Water and Air Research, Inc. 1983. Initial Assessment Study of Marine Corps Base, Camp Lejeune, North Carolina. Prepared for Naval Energy and Environmental Support Activity. Section 2.4 Page 2-8, Section 3.4 Page 3-3, and Section 4.4 Page 4-16
2	aquifers at Site 35	Section 2.1	CH2M HILL. 2009. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 4.3 Pages 4-2 through 4-6, Figures 4-4 and 4-5
3	average hydraulic conductivity	Section 2.1	CH2M HILL. 2009. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 3.4, Pages 3-5 and 3-6
4	COCs at Site 35	Section 2.3	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Section 2.8 Page 2-9
5	sampling strategy	Section 2.3	CH2M HILL. 2009. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 2.4 Pages 2-3 through 2-12 and Table 2-1
6	pilot studies	Section 2.3	Baker. 1996. *In-situ* Air Sparging Treatability Study Report Operable Unit No. 10 (Site 35). Marine Corps Base Camp Lejeune, North Carolina. November. CH2M HILL. 2006. Final Pilot Study Report, Site 35, Operable Unit No. 10, Marine Corps Base Camp Lejeune, North Carolina. March. CH2M HILL. 2008. Non-time-critical Removal Action, Site 35, Operable Unit No. 10. Marine Corps Base Camp Lejeune, North Carolina.
7	contaminated soil	Table 1	Baker, 1994b. Final Interim Record of Decision for Contaminated Soil at Operable Unit No. 10, Site 35 – Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. August. Section 9, Pages 33 through 35
8	Air sparging	Table 1	Baker. 1995. Final Interim Record of Decision for Surficial Groundwater for a Portion of Operable Unit No. 10, Site 35 – Camp Geiger Area Fuel Farm. Marine Corps Base, Camp Lejeune, North Carolina. September. Section 9, Pages 23 through 26

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
9	soil was removed	Table 1	OHM Remediation Services Corp. (OHM). 1997. Final Contractor's Closeout Report, Soil Remediation, Operable Unit No. 10, Site 35, Marine Corps Base Camp Lejeune, North Carolina. May. Section 2
10	LTM was discontinued	Table 1	CH2M HILL. 2005. Optimization of the Long-Term-Monitoring Program, Marine Corps Base Camp Lejeune, North Carolina. September. Section 4.1 Page 4-1
11	biological degradation	Table 1	CH2M HILL, Inc., Baker Environmental, Inc., and CDM. 2003. Final Natural Attenuation Evaluation Report, Operable Unit 10, Site 35, Former Camp Geiger Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. April. Section 6, Pages 6-1 through 6-4
12	site-wide sampling	Section 2.3	Baker Environmental, Inc. (Baker). 1994. Interim Remedial Action, Remedial Investigation, Operable Unit No. 10, Site 35 – Camp Geiger Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. July. Interim RI Section 3, Starting Page 3-1 Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 4 Starting Page 4-1
13	excavation activities	Section 2.3	OHM Remediation Services Corp. (OHM). 1997. Final Contractor's Closeout Report, Soil Remediation, Operable Unit No. 10, Site 35, Marine Corps Base Camp Lejeune, North Carolina. May. Section 2
14	Groundwater treatment	Section 2.3	CH2M HILL. 2008. Non-time-critical Removal Action, Site 35, Operable Unit No. 10. Marine Corps Base Camp Lejeune, North Carolina. Section 7 CH2M HILL. 2006. Final Pilot Study Report, Site 35, Operable Unit No. 10, Marine Corps Base Camp Lejeune, North Carolina. March. Section 6 CH2M HILL. 2003. Technology Evaluation Operable Unit No. 10 (Site 35), Marine Corps Base Camp Lejeune, North Carolina. June. Section 7 Page 27 and Page 28
15	analytical results	Section 2.3	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Table 2-4, Table 2-5, Table 2-6, Figure 2-10, Figure 2-11, Figure 2-12, Figure 2-13, Figure 2-14, Appendix A

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
16	Human health risk assessments	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 6 Starting Page 6-1 Baker. 1996. Draft Supplemental Groundwater Investigation, Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. November. Section 6 Starting Page 6-1 CH2M HILL. 2009. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 7 Starting Page 7-1
17	Potential receptors	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 6 Figure 6-1
18	do not pose an unacceptable risk	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 6, Table 6-24 to Table 6-28 CH2M HILL. 2009. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 7, Table 7-3
19	future residential receptors	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 6.5.1 Page 6-30, Section 6.7 Page 6-35 and Tables 6-23 to 6-28 Baker. 1996. Draft Supplemental Groundwater Investigation, Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. November. Section 6, Table 6-5, Table 6-6
20	point of exposure	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 7.2, Pages 7-2 through 7-14 CH2M HILL. 2009. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 8.2.2 Page 8-7

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
21	terrestrial and aquatic receptors	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 7.7 CH2M HILL. 2009a. Supplemental Remedial Investigation, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm, Marine Corps Base Camp Lejeune, North Carolina. March. Section 8.2.2, Page 8-7
22	pesticides and metals	Section 2.5	Baker. 1995. Final Remedial Investigation at Operable Unit No. 10 (Site 35, Camp Geiger Area Fuel Farm), Marine Corps Base Camp Lejeune, North Carolina. May. Section 7.7
23	initial screening of technologies	Section 2.8	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Table 3-5, Section 3.3 Page 3-3
24	nine evaluation criteria	Section 2.8	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Section 5.1 Page 5-2
25	rate of natural biodegradation	Section 2.8	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Section 2-11 Pages 2-19 through 2-21, Tables 2-8 through 2-10, Appendix B
26	Projected capital costs	Section 2.8	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Section 5.3.7, Table 5-2, Appendix C
27	Predictive modeling	Section 2.9.2	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Section 2.11 Pages 2-19 through 2-22, Tables 2-8 through 2-10, Appendix B
28	natural biodegradation is occurring	Section 2.9.2	CH2M HILL. 2009. Feasibility Study, Site 35 – Operable Unit No. 10, Camp Geiger Area Fuel Farm. Marine Corps Base Camp Lejeune, NC. March. Section 2.10 Pages 2-14 through 2-19, Section 4.2.2 Pages 4-2 and 4-3

Detailed site information reference in this ROD in bold blue text is contained in the Administrative Record.

For access to information contained in the Administrative Record for MCB Camp Lejeune please contact:

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